ABSTRACT

[Index No.: 163/15/Phys/24]

Title: Development of Finger Clubbing Monitor and Serum Calcium Detector as an Early Indicator of Cardio-Pulmonary Diseases.

Finger Clubbing is an important early clinical symptom indicating several sever health disorders, mostly related to cardio-pulmonary malfunctioning in human beings. Finger clubbing is identified as the deformation of the human finger into a bulbous tip appearance. This key clinical symptom is associated to several underlying health disorders including lung cancer. In this work the phalangeal depth ratio and the profile axis angle of the finger is monitored by the development of an automated instrument that undertakes and analyses the above mentioned parameters for quantitative and precise detection of finger clubbing. As the presence of finger clubbing in one is strongly associated with lung cancer, hence a more conclusive approach towards its diagnosis can be achieved by monitoring the serum calcium level. Since lung cancer is almost invariably associated with a drastic increase in serum calcium levels, a condition called "hyper-calcemia", in this work a calmodulin surface-functionalized, porous silicon based calcium detecting biosensor has been developed.

Biosensors by definition is a device used to detect chemical compounds by using specific biochemical reactions mediated by isolated organelles, whole cells, tissues, enzymes or immune systems, usually by optical, electrical or thermal signals. Porous silicon owing to its significantly high surface area for absorption, easily modulable porosity and high biocompatibility severs as perfect material for bio-sensing application. Calmodulin being a common protein in all eukaryotic cells acts as effective calcium binders due to its high affinity towards calcium ions. Porous silicon with its many-fold increase in surface area for absorption, surface-functionalized with calmodulin, acting as active calcium binder provides the perfect platform for calcium detector fabricated in this work. Electrical response like the variation of current with varying voltage and variation of capacitance with varying frequency of input voltage, together with the optical parameter response like reflection peak intensity loss, scattering loss and absorption loss of the fabricated detector platform are analyzed in order to establish the selectivity of the detector towards calcium ion. The detector displays high affinity towards calcium ion by exhibiting discriminative response for calcium in presence of other mono and bi-valent interfering ions at biologically relevant concentrations. Optimization of the detector platform, to enhance its response as a calcium detector is performed by studying the change in the electrical and optical response of the detector by modulating the preparation etching parameter of the porous silicon substrate like etching time of preparation. The optimized detecting platform provides a precise, sensitive, robust, cost-effective and level-free, multi-parametric approach

towards calcium detection that may find use in scientific studies, food, drug and chemical industries and most importantly in medical and pharmaceutical industry as an effective clinical diagnosis tool. This study thus provides a two stage early diagnosis for any person with underlying cardio-pulmonary disorders like lung cancer, so that through this early screening process effective medical help can be sought at a very preliminary stage that can ensure better prognosis for such patients.

(Signature of Candidate)

Kaustav Sen

(KAUSTAV SEN)

(Signature of Supervisor/s)

(1)

(Dr. JAYOTI DAS)

Dr. Jayoti Das
Professor
Department of Physics
Jadavpur University
Kolkata - 700 032

(2)

(Dr. SYED MINHAZ HOSSAIN)

Dr. S. M. Hossain
Associate Professor & Head
Department Of Physics
Indian Institute Of Engineering Science & Technology, Shibpur
Howrah - 711103